Review of Yan et al. *Regional variability in East Antarctic surface accumulation over the past 162 kyr inferred from englacial stratigraphy at the southern flank of Dome A*

In this contribution, Yan and colleagues use a 2.5D flowband model constrained by newly dated englacial stratigraphy to infer a new surface mass balance history for the region of East Antarctica between Dome A and South Pole. The headline result is in Figure 7: the technique derives a new accumulation history for the region which matches the broad 160 ka to present interglacial-glacial-interglacial histories derived directly from ice cores (e.g. EDC, Vostok) but suggesting lower accumulation during the last interglacial and higher accumulation for the last glacial period. A broader message is the demonstration that englacial stratigraphy together with flowband modelling can be used to derive plausible accumulation histories away from ice divides and existing ice cores.

During the review process I shared the submission with my early-career colleagues in Edinburgh, Harry Davis and Clara Nyqvist. We each reviewed the paper separately then met at the end to share views, and this review represents our collective suggestions.

We all agreed that the paper is well written and scientifically sound, and consider it worth publication subject to a few minor revisions. The largest change we would like to see is a fuller description of the IRH-age assignment and attribution if the promised companion paper is not already published as this paper progresses further through review.

<u>IRH age assignment and attribution</u>

Given the dependency of the modelling – and hence the paper's main takeaways – on the dating of the IRHs, the processes by which the IRH ages and uncertainties were derived need some more discussion in this paper. We get it that these details are promised to us in a companion paper that is currently under review – so the easiest fix will be that this companion paper is published and can therefore be cited instead of the Singh et al (2023) conference abstract in L78.

However – if that companion paper retains the status of *not* being published as this paper aims to progress through review, then pointing to that abstract alone does not give enough detail, and we suggest that as the dating/uncertainties are introduced in the paragraph ~L76 there are some sentences added to provide some more background on: Fundamentally where are the dates derived from? The Singh et al. (2023) conference abstract alludes to the timescale being propagated from the pre-existing ice-core chronology from the PPT survey – but only a reader well immersed in the history of studies in this area is going to follow what that means. Please explain how the PPT age-scale and uncertainties were derived. Are there extra uncertainties added at crossovers between PPT and COLDEX (and Sanderson et al and COLDEX)? Are the assigned dates derived from the very latest ice-core chronology/chronologies? Might the dates and uncertainties be refined if they were tied to the timing of global volcanic events – following the lines suggested in Franke et al. (2025) Section 4.2 and as considered in Davis et al. (2026)?

The issue of dating control on the 9 IRHs used could also be added into Section 5.4 Limitations and Future Work. At the moment this section *does* discuss dating control, but pertaining only to the issue of the dependence on 9 IRHs and the large gaps between traced IRHs lower in the ice. So, this section could be expanded to discuss the separate issue that potentially, with new insights from ice-core chemistry and further tightening of an Antarctic-wide isochrone chronology, dating control of the traced IRHs may become tighter, uncertainties reduced, etc.

None of this suggested additional material – which ought to amount to just a few extra sentences overall – needs to compromise the promised companion paper that will presumably focus on many more details of the englacial stratigraphy.

Minor revisions

There is some interchangeability in the terms: layers, englacial horizons, internal-reflection horizons, (just) horizons, and isochrones. In the AntArchitecture paper the community recommended using internal-reflection horizons (IRHs) for cases where dating is not applied, and isochrones for cases where it is.

In-text citation strings: We recommend these are ordered chronologically by order of publication, rather than alphabetically. When I (Rob) look at citation strings in any sentence of any paper I am already trying to follow the chronological order in which the various developments were published that support the points being made in a given sentence, so listing them chronologically is a more logical way to support critical engagement.

L39: What is recent to some is distant to others, and since at least one citation is from 2011, this sentence could start "Some comparisons…." or even "Some direct comparisons…"

L39: Extra hyphen needed after core: "…between ice-core- and radar-derived…"

L61: Why specifically cite the Kerr et al. (2024) conference abstract here? Is there anything it says that is crucial to support this sentence that Kerr et al. (2026) does not?

L62: On this first mention of MARFA, please expand the acronym and put MARFA in brackets before/after.

L69: We suggest "traced" rather than "mapped".

Figure 1: We suggest the area covered by each panel is enlarged to incorporate Dome A. Partly this would be to allow annotation onto at least one figure in the paper of the sites of Dome A – and we also suggest annotating onto one or both panels the locations of South Pole and Recovery Subglacial Highlands. We acknowledge that experienced readers know these locations, but this will help accessibility to readers new to the field, e.g. undergraduate students that we hope are inspired by papers such as this. If this is done, there is also the option in panel (a) to annotate the modelled profiles extending to Dome A, maybe as dashed lines? Regarding the annotation of South Pole – if it is clarified that the dating control for this paper essentially ties to SPICEcore, consider whether the annotation should be SPICECore rather than South Pole, and to explain what SPICEcore means, and its relevance to the dating control, in the figure caption.

L78: Add *identified*: "…the 161.9 ka horizon identified by Sanderson…"

Figure 2: Please consider annotating the IRH dates and uncertainties to each radargram panel. To do this with sufficiently legible font size may require elongating the vertical scaling of the figure as a whole. As an additional suggestion, we interpret that the profiles A-D are rendered always with Dome A to the right, and that the symbols in the bottom right of each radargram are supposed to render this information, but at the moment this is only interpretable through symbols and it might be worth clarifying this in the text of the figure caption.

L110: From what citation(s) are the values for accumulation and temperature derived?

L119: We suggest it would be clearer to rephrase "along the Dome A-South Pole corridor" to simply "between Dome A and the South Pole".

L132: One word: hydrogeological

Figure 3: Since L129 mentions Recovery Subglacial Highlands and South Pole, these names should really be annotated on to at least one of the panels of this figure. Maybe also annotate RSH on to Figure 1b too?

Figure 3: Maybe this is cosmetic, but the colourscales for each panel could be emplaced within each panel, and overall the figure could be formatted as a column, rather than spanning the full page width and needing to fill a fourth quadrant with the legends.

L162: No hyphen needed here for ice flow.

L182: Hyphen needed between basal and unit.

L185-190: Please can you clarify in the writing how you knit together the COLDEX topography and accumulation datasets with Bedmap3 and RACMO2.4 respectively to avoid any boundary effects? There are presumably some parts of the boundary where there would be a sharp change in values, but has some smoothing been operated across the boundary to ameliorate this? Would sharp or smoothed transitions across these dataset boundaries be expected to affect the model outputs?

L194: remain, rather than remains

L203: Rephrase: "…its transient evolution requires assumptions…"

L206: Rephrase: "…surface elevation and position of the divide (Dome A in this case) can change…"

L230-285: Is it also worth writing a bullet point that makes clear that there is not a clear variation in any of these trends through the full north-south extent of each of these profiles?

Figures 4 and 6: We interpret (but it is never said explicitly) that in each of these figures the colourscales are marked along the traced positions of the observed isochrones, rather than along the positions of the modelled isochrones? This could be worth clarifying in the caption at least to Figure 4 if not both figures. For both figures it would also help to have a scheme of annotating the ascribed dates to each IRH, as we have also suggested for Figure 2. Perhaps to achieve this clearly (i.e. to allow labels to be added with legible font size) you might have to expand the vertical depth of each panel hence overall make each of the figures cover more of a full page.

L257: Is it correct that L1 is included in this line? because from Table 1 L1 is apparently not included in the exercise discussed here.

L274-277: From where specifically in Figure 5 do you derive the ranges 5-33%, 30-98% and 18-38%? This can be more clearly specified in the text.

L274-277 (a second query): So, then, for producing Fig. 6, what accumulation values are actually used for each panel? Between 10.9 and 40.8 ka, for example, are the results in Fig. 6 derived by using a single value from within the range 5-33%, or does the accumulation value over that time period vary between 5-33%, and if so how?

Figures 5 and 8: You could usefully annotate as a title onto each panel: Profile A, Profile B etc.

Figure 5: Shouldn't these curves (or at least the points) have error bars? Each of the depth ranges is derived from boundary isochrones that have uncertainties…

Table 1 caption: Remove "…and will be described in detail in a comparison manuscript under review". This relates to the earlier point that some of these details need to be in this paper, unless the companion paper is now published.

Figure 7: Suggest adding a green box to the legend, labelled something like "Modelled/this study".

L347-L354: This section appears to ignore some apparent large departures from the general pattern of the curves, for example in panel c where a number of younger IRHs dip down between 375 and 250 km, and in panels b, d, and to a certain extent c, where the oldest IRH is way out of kilter on the right-hand side.

L398-399: Because they both include some presentation of synthesising traced IRHS across wider East Antarctica, we suggest adding Franke et al. (2025) and Nyqvist et al. (2026) to this citation string.

L466: The "sentence" beginning "In particular…" does not read as a grammatically correct sentence. It should either be merged with the previous sentence, or rephrased to render it a full sentence in isolation.

References

Davis et al. (2026) Assessing the potential for an ice core in the southern Antarctic Peninsula to elucidate Holocene climate history. *The Cryosphere*, 20 (5), 2735-2756.

Franke et al. (2025) Age–depth distribution in western Dronning Maud Land, East Antarctica, and Antarctic-wide comparisons of internal reflection horizons. *The Cryosphere*, 19, 1153-1180.

Nyqvist et al. (2026) Ice-core-dated englacial stratigraphy across Wilkes Subglacial Basin, East Antarctica: Implications for ice-sheet behaviour. *Journal of Glaciology*, 72, e96.